The search for fresh craters in the MSL landing ellipses

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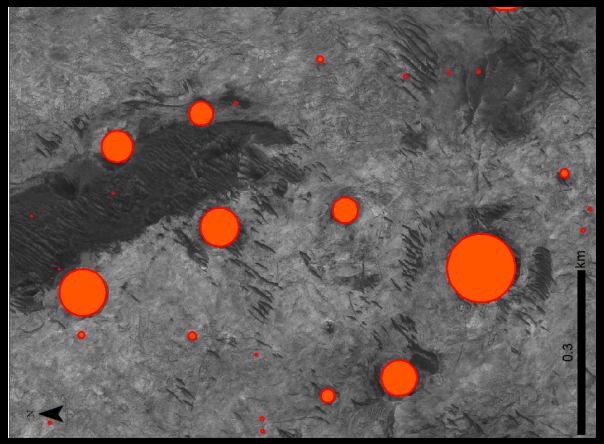
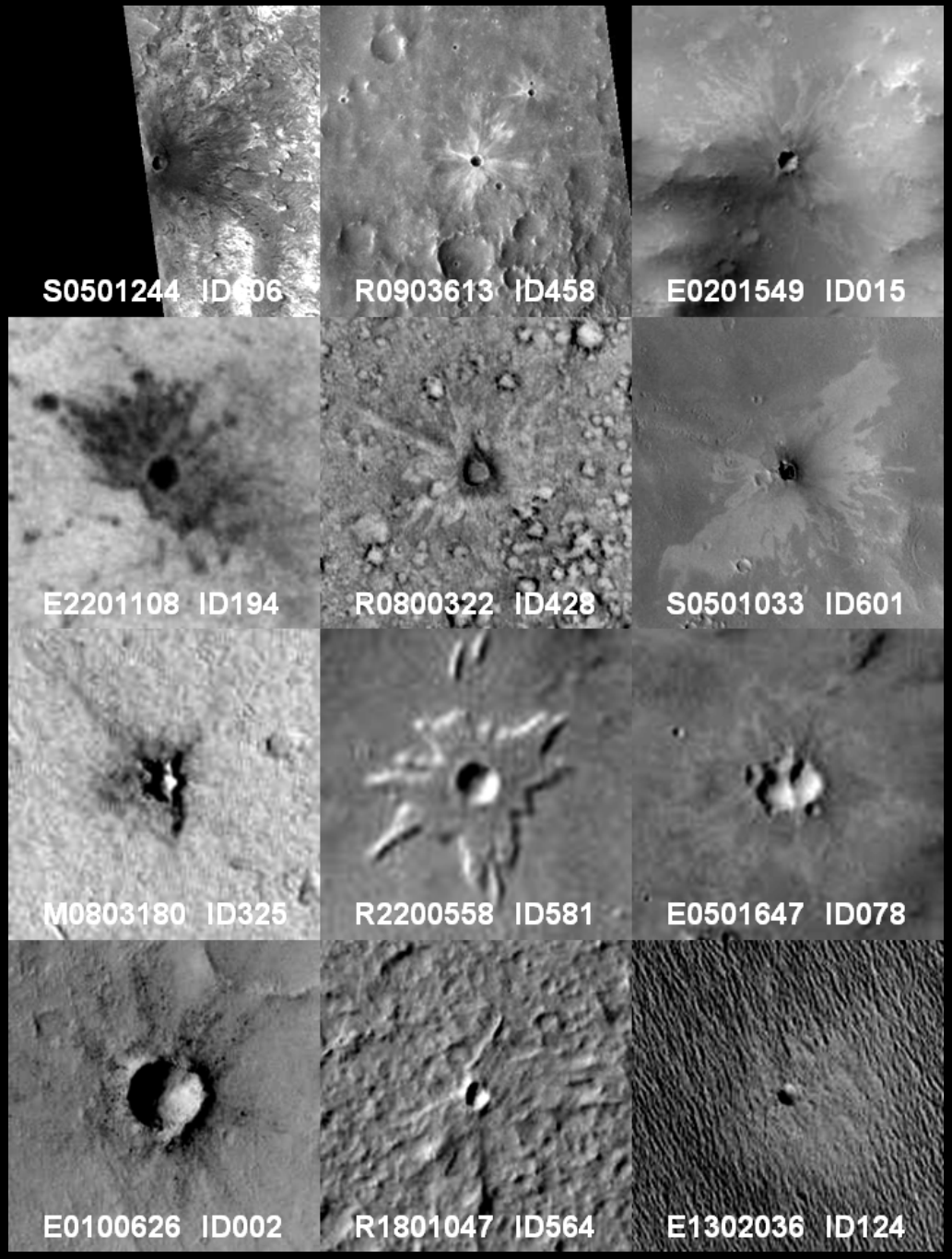
Caltech

STUDY GOALS

- Identify “fresh” craters in each MSL landing ellipse as potential targets of interest for sampling.
- Characterize the geologic surfaces within each ellipse in terms of crater retention.





- Small diameter (D < 1 km) "fresh" craters, those that still retain ejecta distally around their rims, provide material excavated from a few meters below the surface.

Calef (2011), Global Distribution of Small Rayed Craters on Mars: Sequences of Ejecta Retention, *LPSC XLII*, #2555

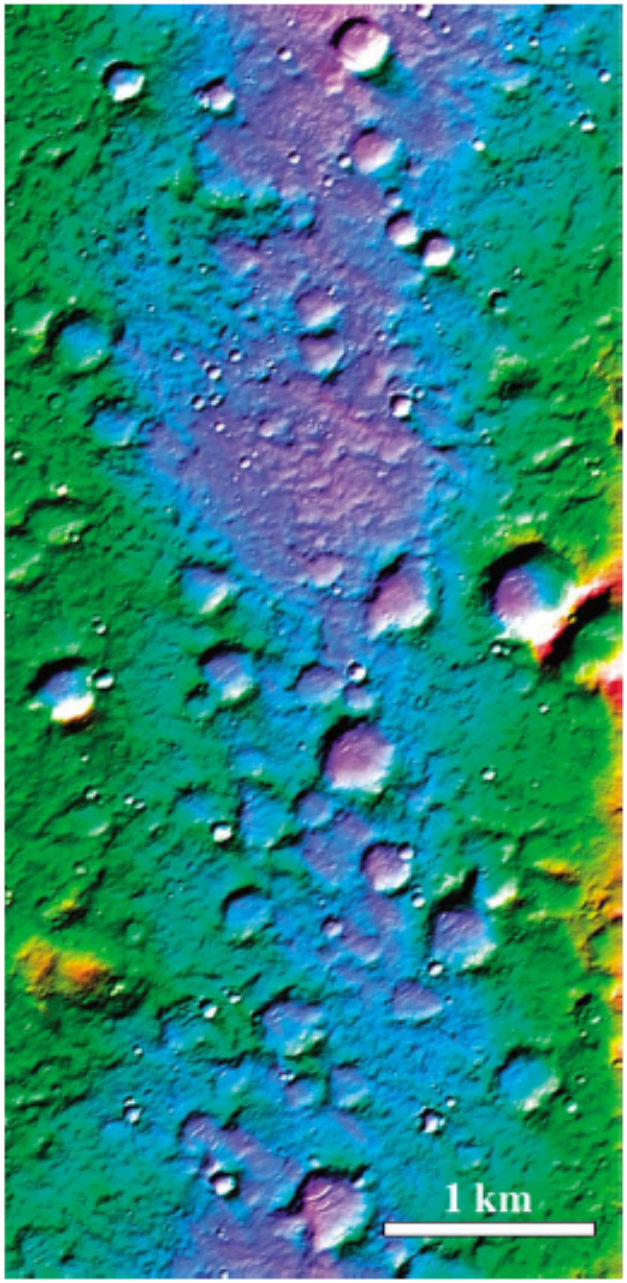
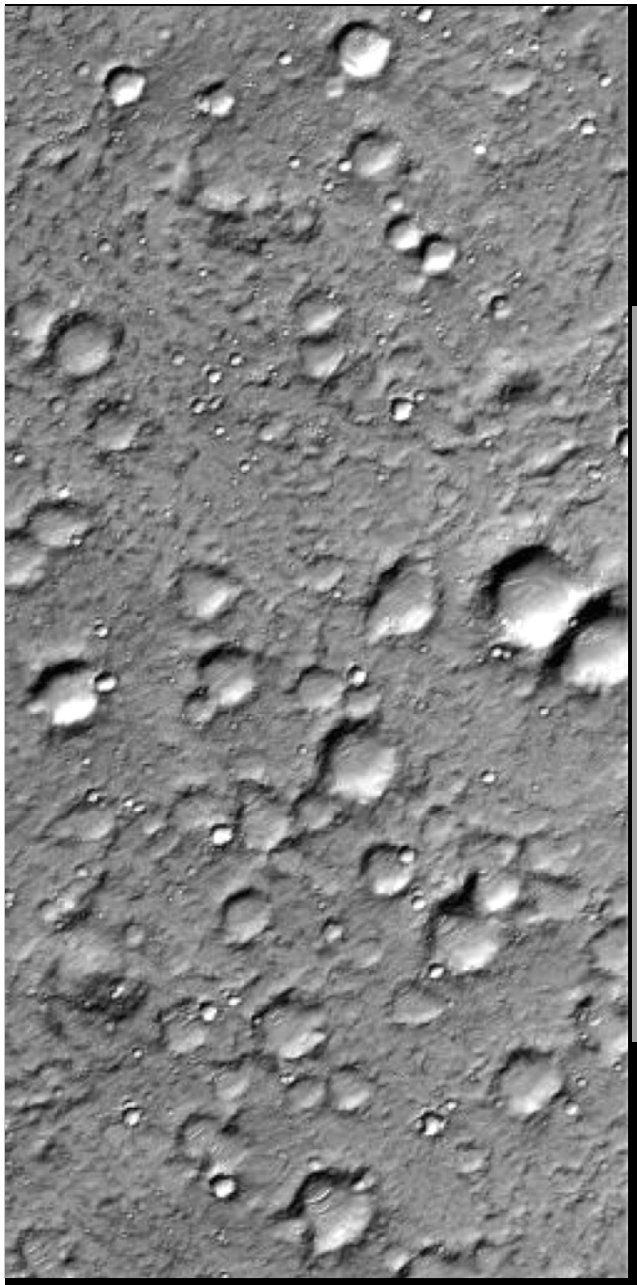


Fig. 19. A portion of a Digital Elevation Model in Gusev crater (Gusev 6), produced from MOC images E19-00218 and E21-00256 [see Table 1 and Fig. 29 of Kirk et al. (2003)]. Image is 3 km wide and the resolution is 3 m/pixel.

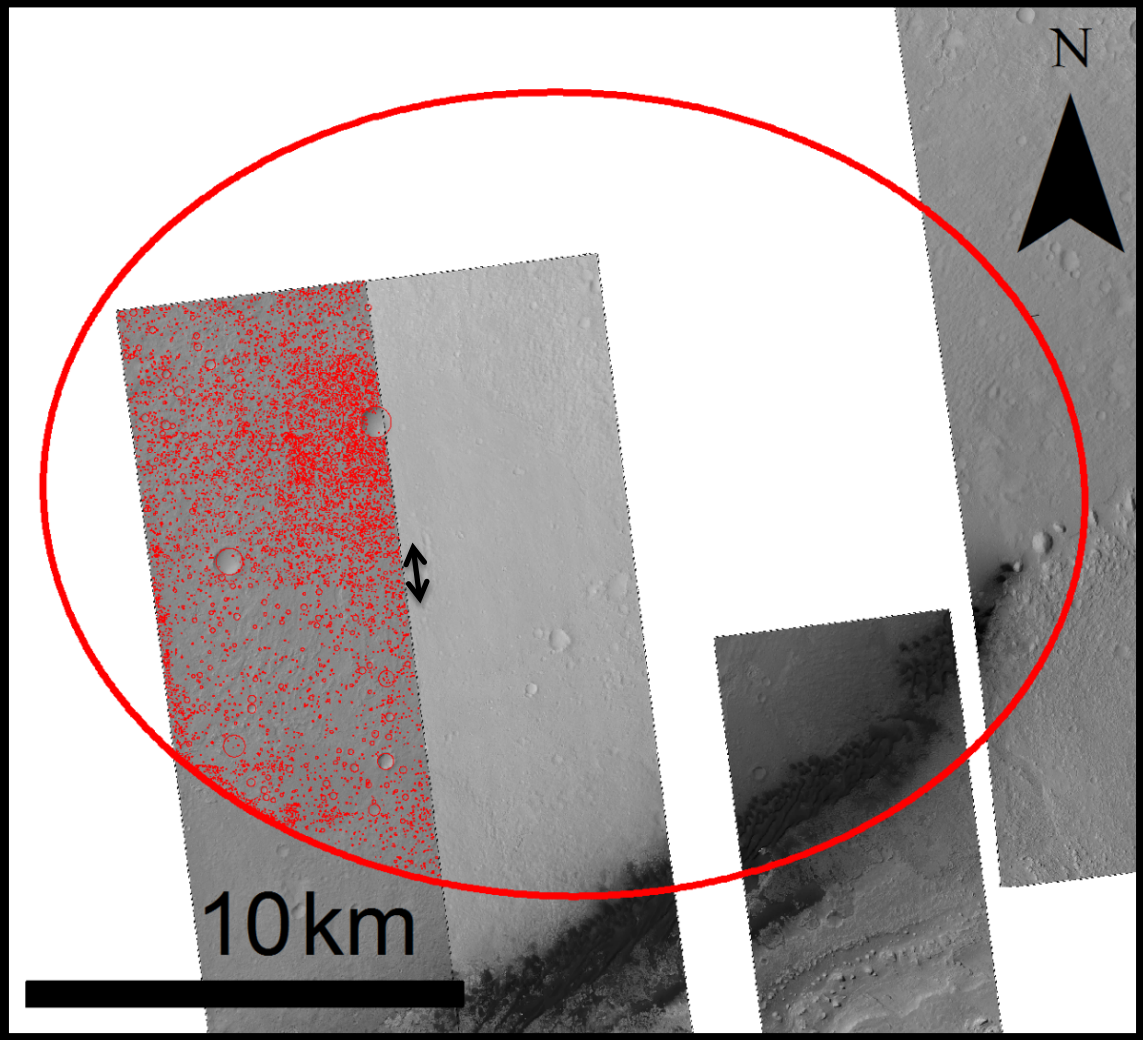


MOCNA E19-00218 Panchromatic (NASA/JPL/MSSS)

A.S. McEwen et al. / Icarus 176 (2005) 351–381

However, most craters are completely devoid of ejecta or remnant blocks and thus are older than those with ejecta.

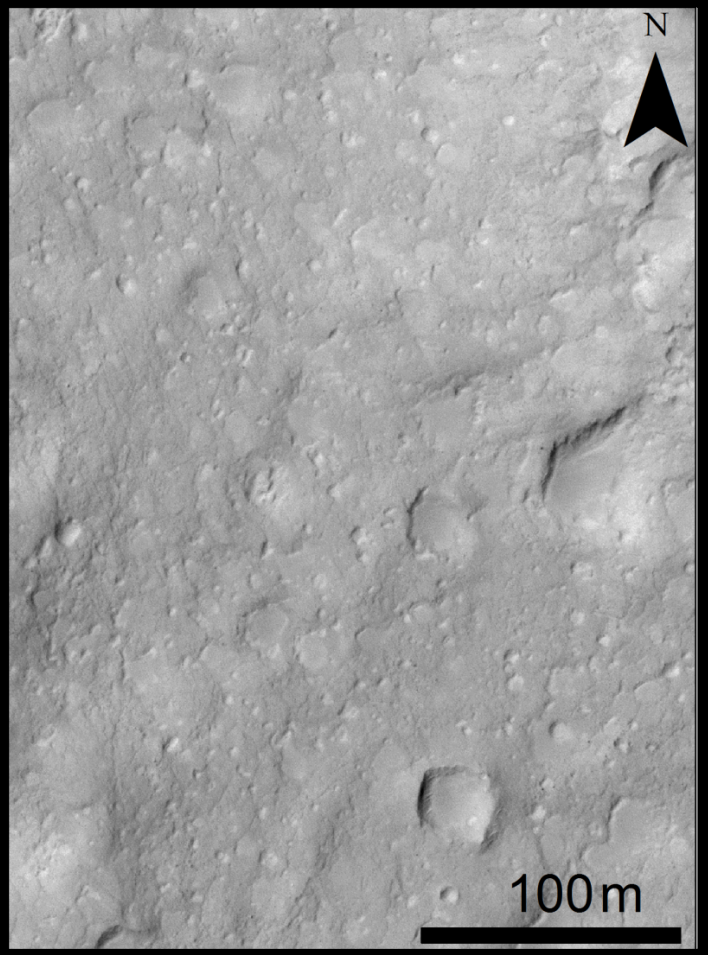
Gale

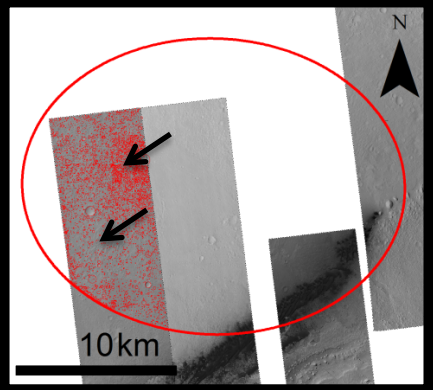


HiRISE images: PSP_009716_1755, PSP_003453_1750, PSP_009861_1755, PSP_009571_1755

- 18,000+ craters
- Covered to 2.5 m radius on north half
- Covered to 15 m radius on south half

Gale

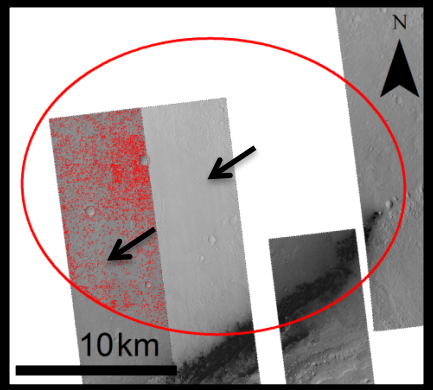


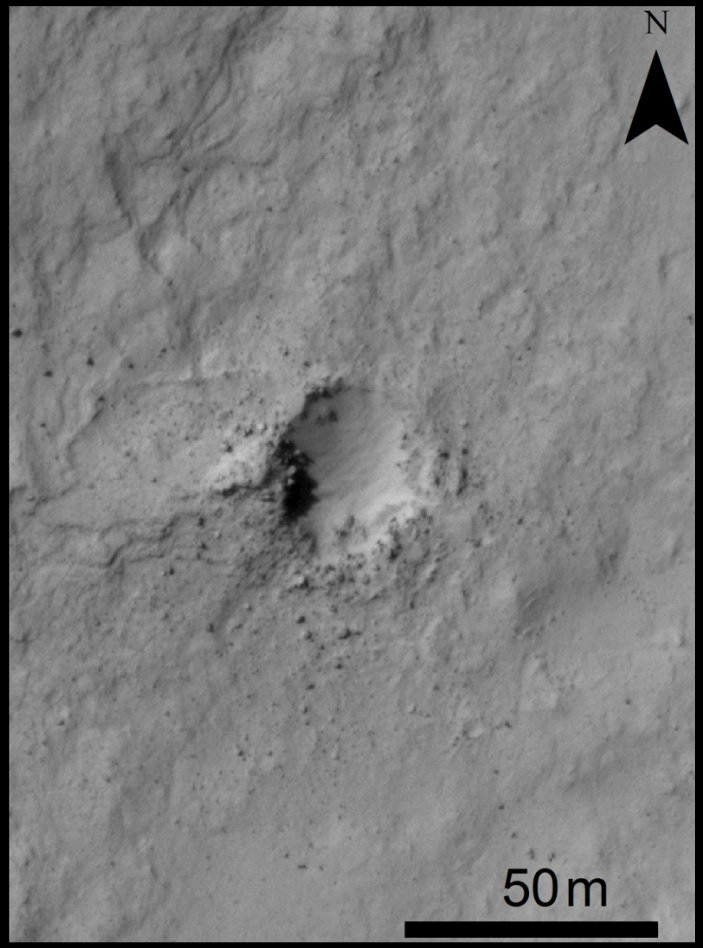


Left: A typical densely cratered area. Right: A typical less densely cratered area. Fresh craters are not common.

HiRISE PSP_009716_1755 enhanced contrast

Gale



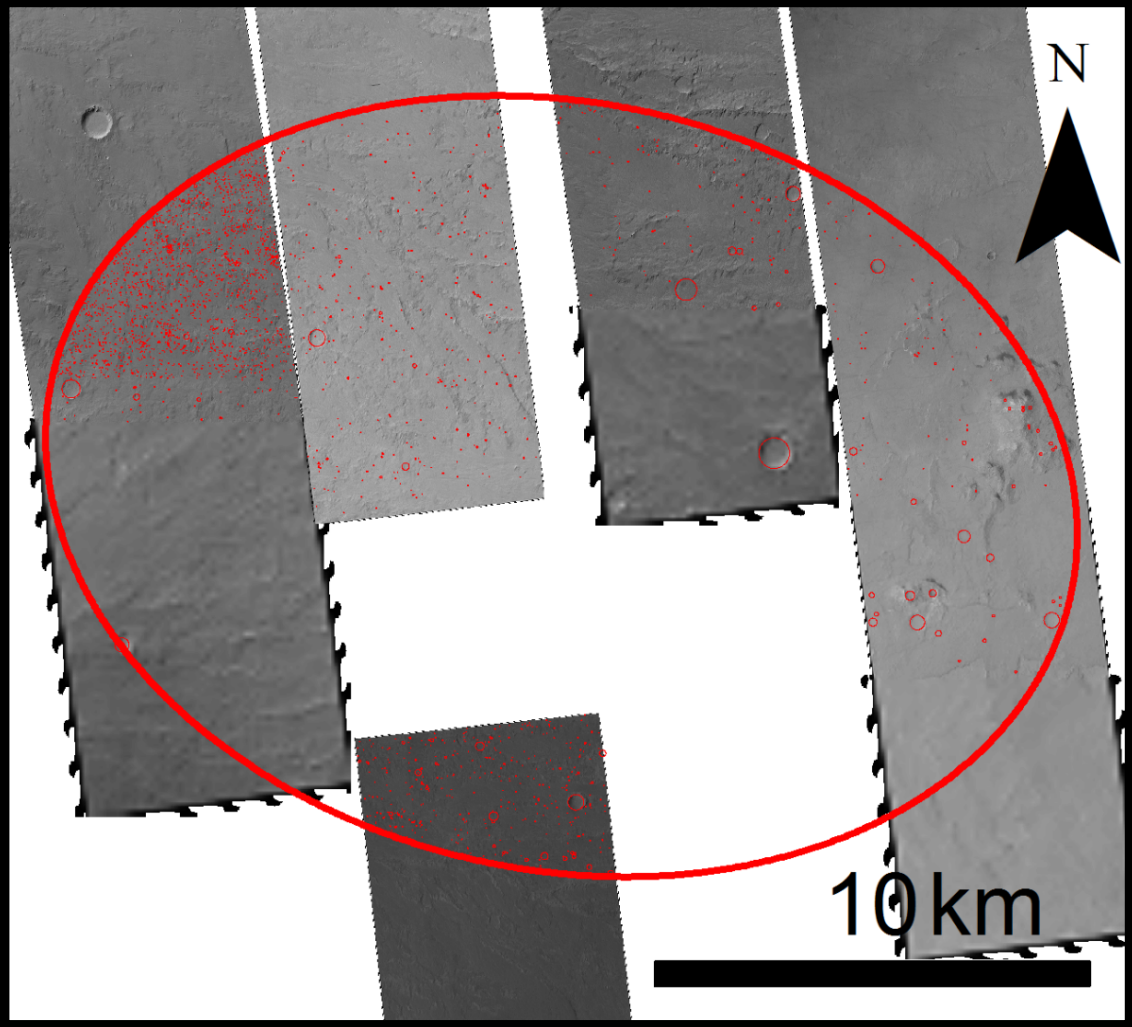


Left: 2x ~10 m radius crater with rays; may be secondaries (irreg. shape)

Right: 15 m radius crater with breccia (not common).

HiRISE PSP_003453_1750 (Left), PSP_009716_1755 (Right), both contrast enhanced)

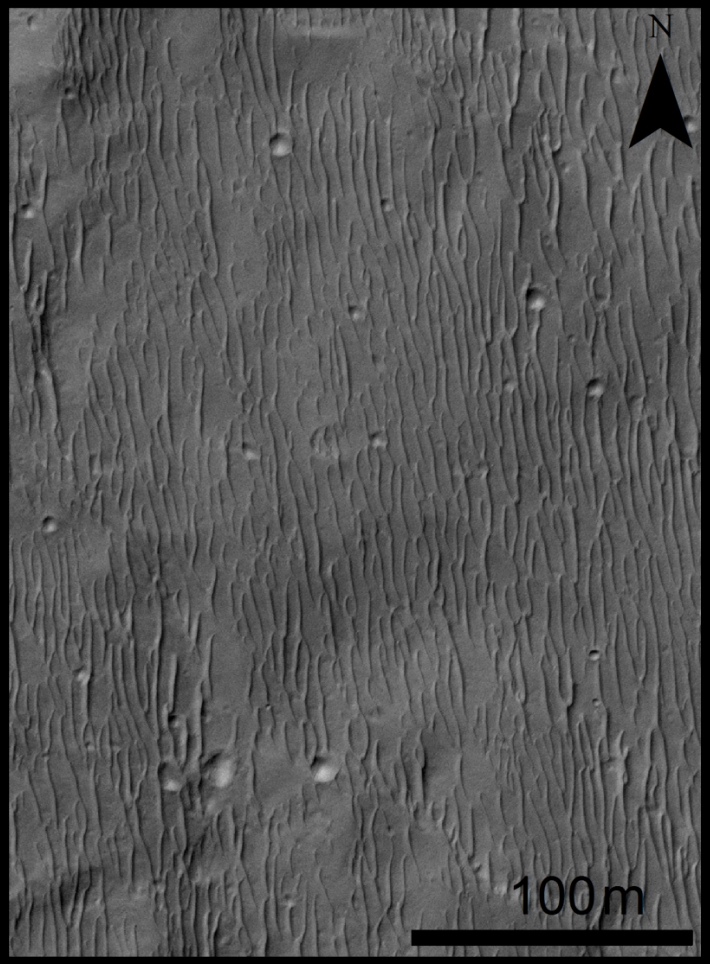
Holden

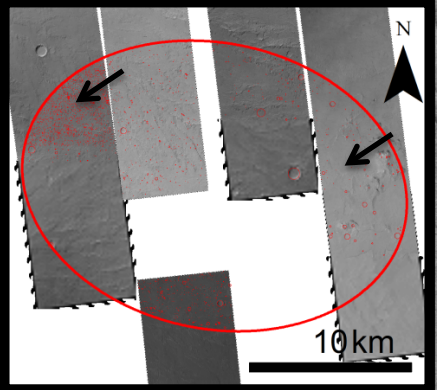


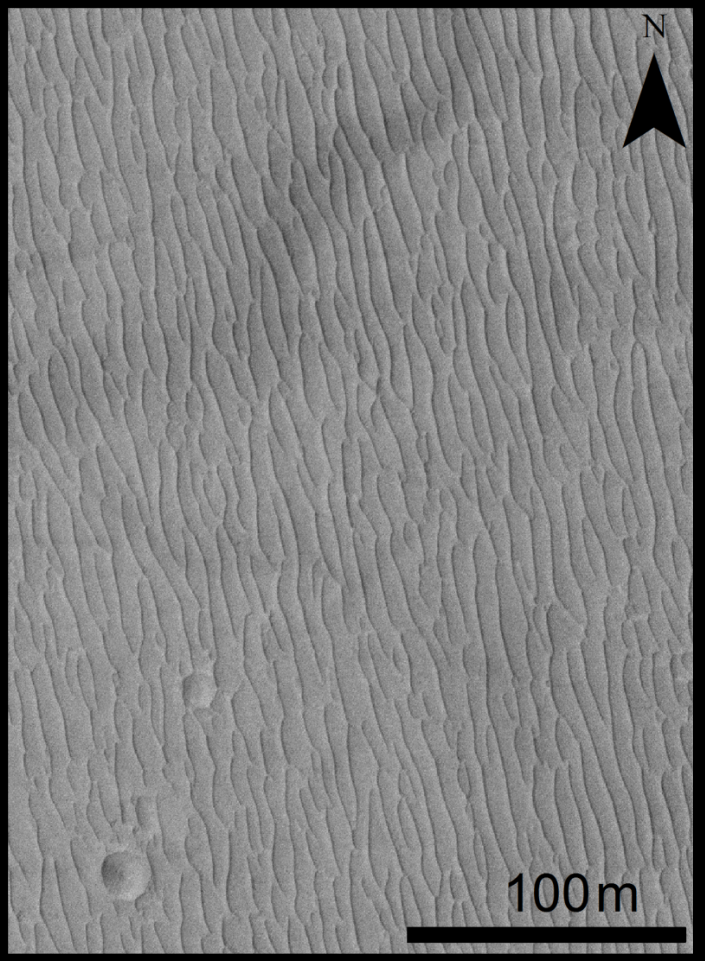
HiRISE images: PSP_006835_1535, ESP_012320_1530, PSP_005411_1535, PSP_008193_1535, PSP_007903_1535

- 7,500+ craters
- Covered to 1.25 m radius to northeast
- Covered to 7 m radius on rest of ellipse

Holden



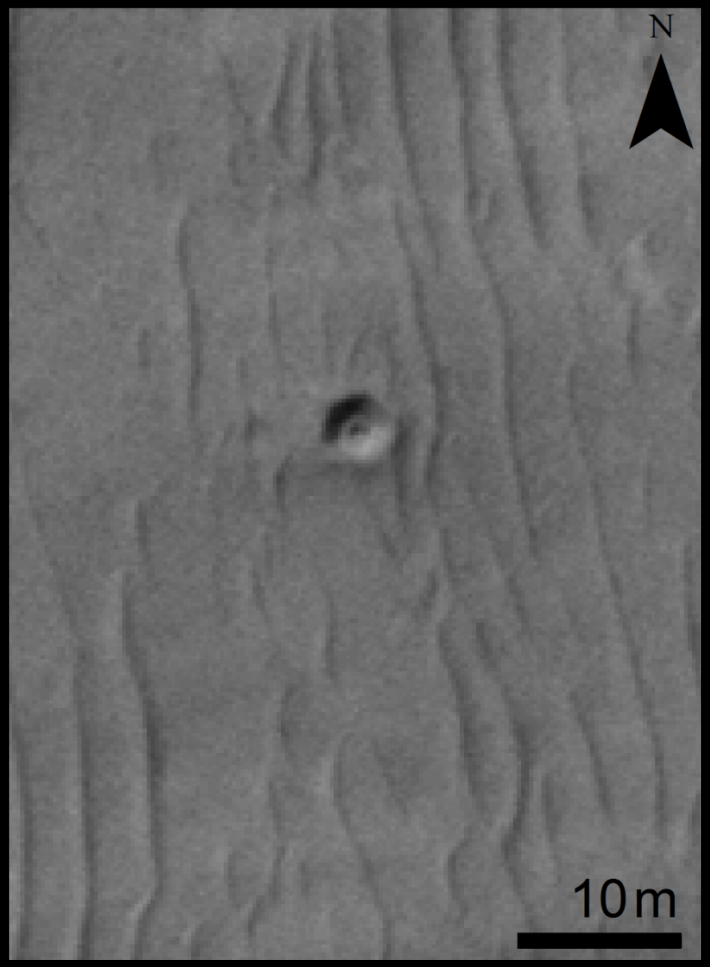


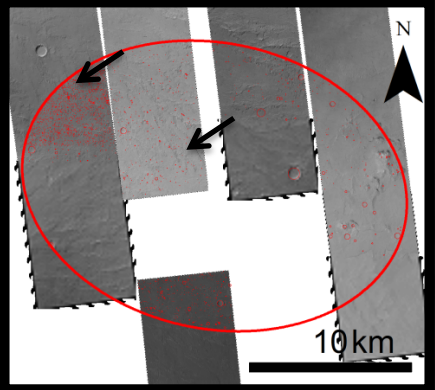


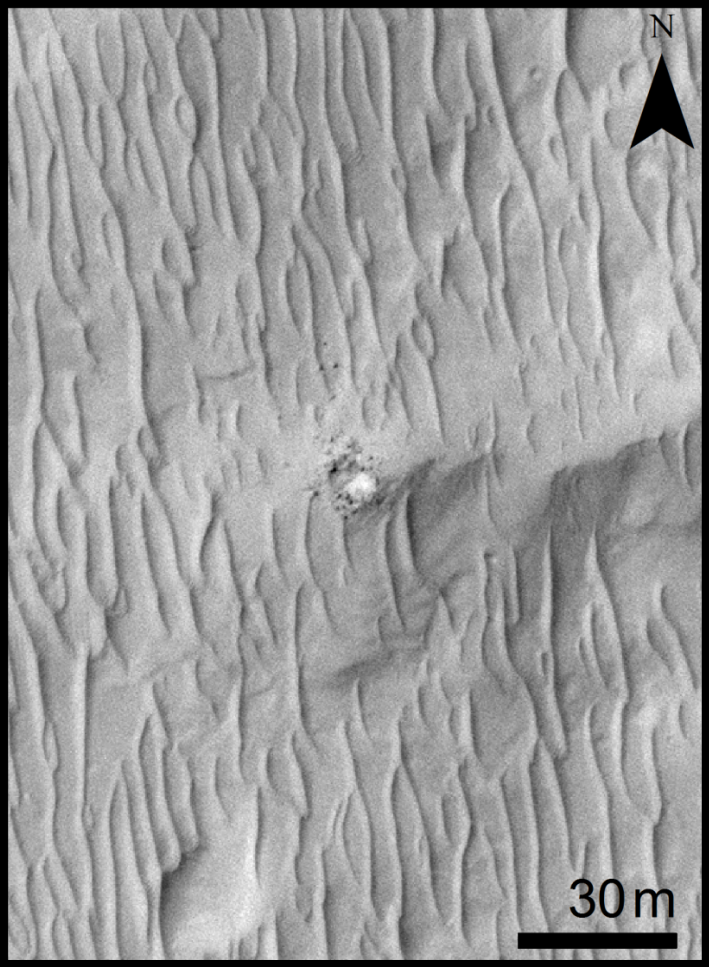
Left: A typical densely cratered area. Right: A typical less densely cratered area. Fresh craters are not common.

HiRISE PSP_007903_1535 (Left), PSP_005411_1535 (Right) enhanced contrast

Holden

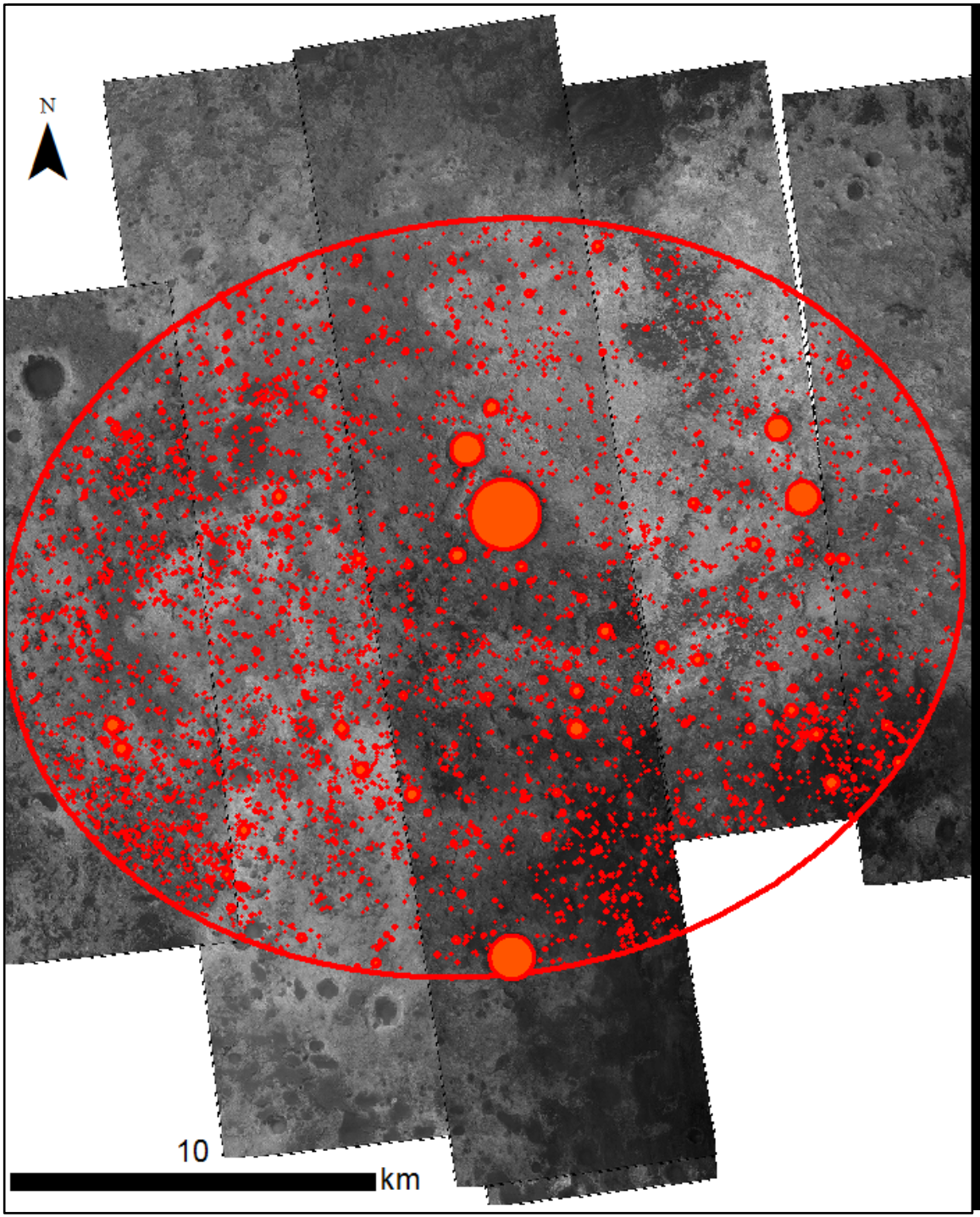






Left: 3 m radius crater; disrupts dunes, has central structure, good rim.
Right: 6 m radius crater with breccia (not common).

HiRISE PSP_007903_1535 (Left), PSP_006835_1535 contrast enhanced (Right)

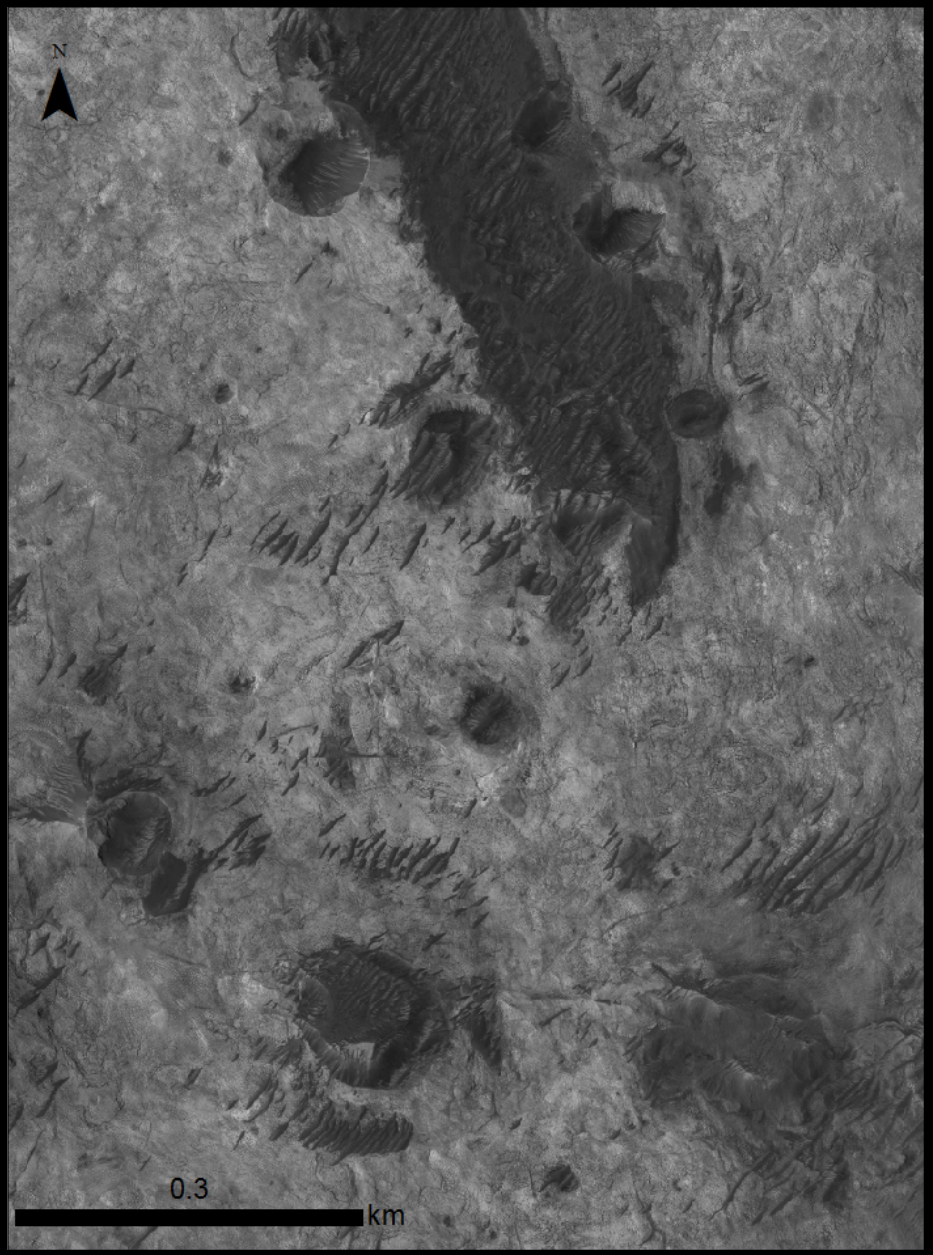


Mawrth

- ~ 6,000 craters catalogued
- 421 km^2 covered
- Diameters ranging from 1 m to 1.9 km

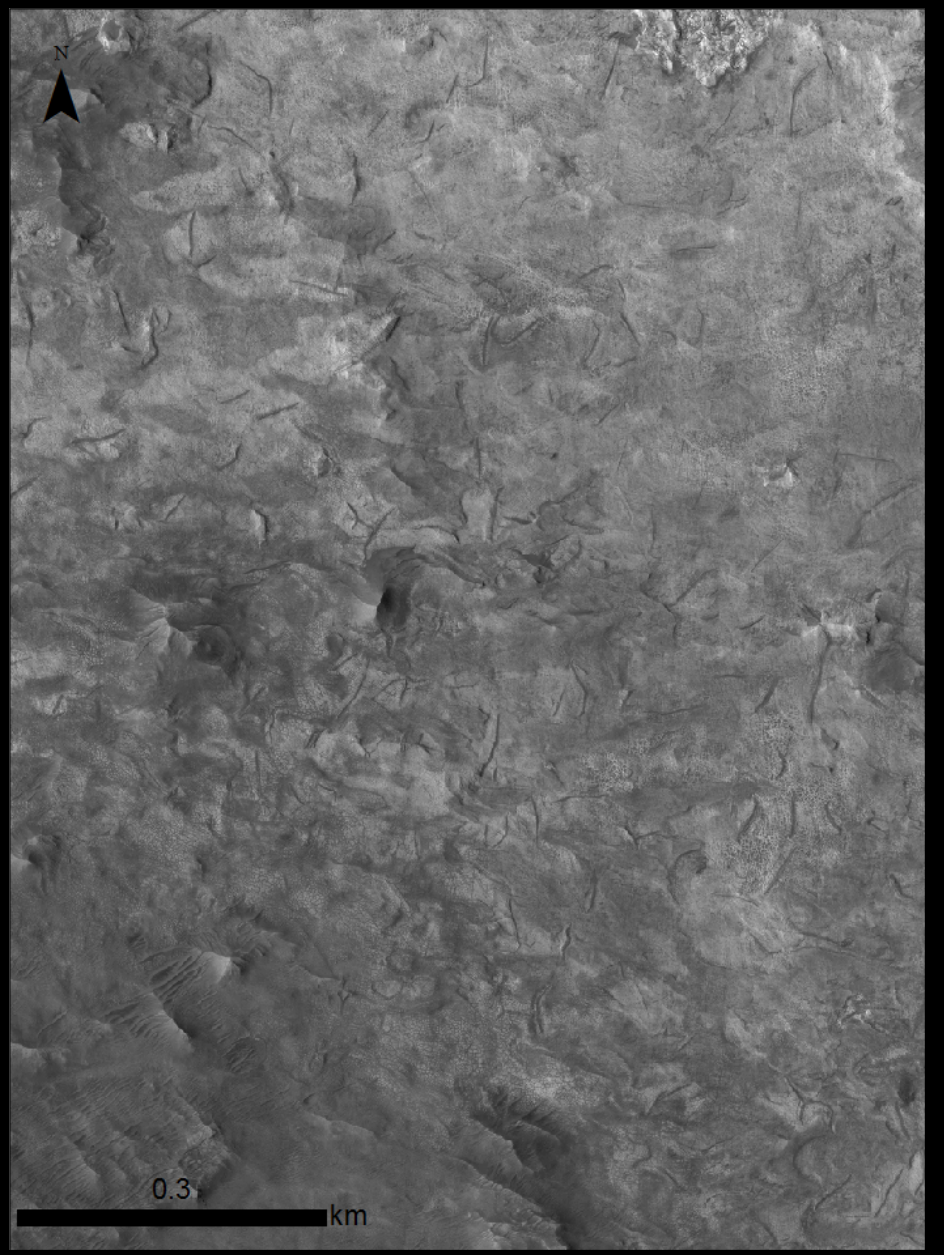
HiRISE image mosaic

Heavily Cratered Terrain

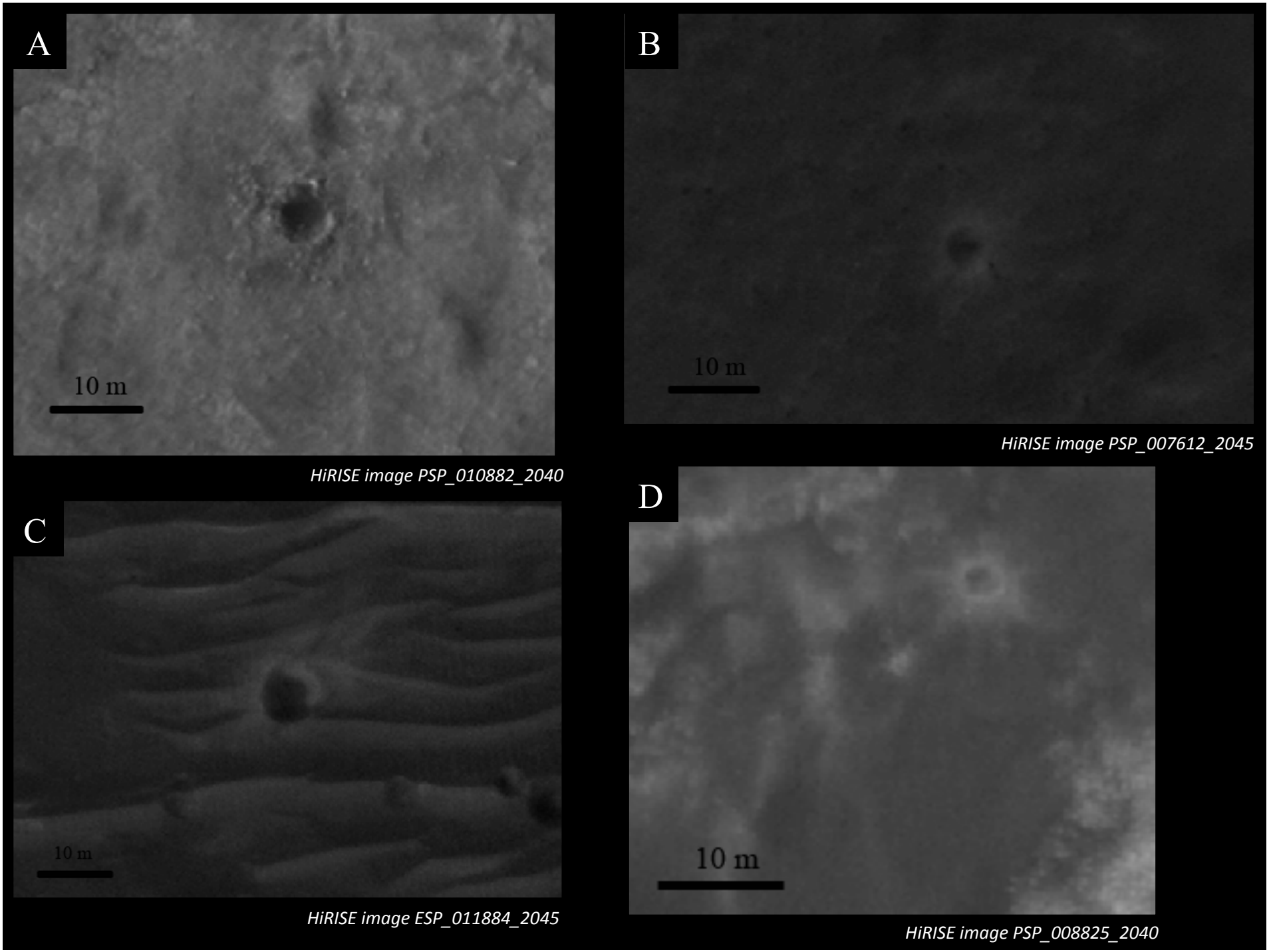


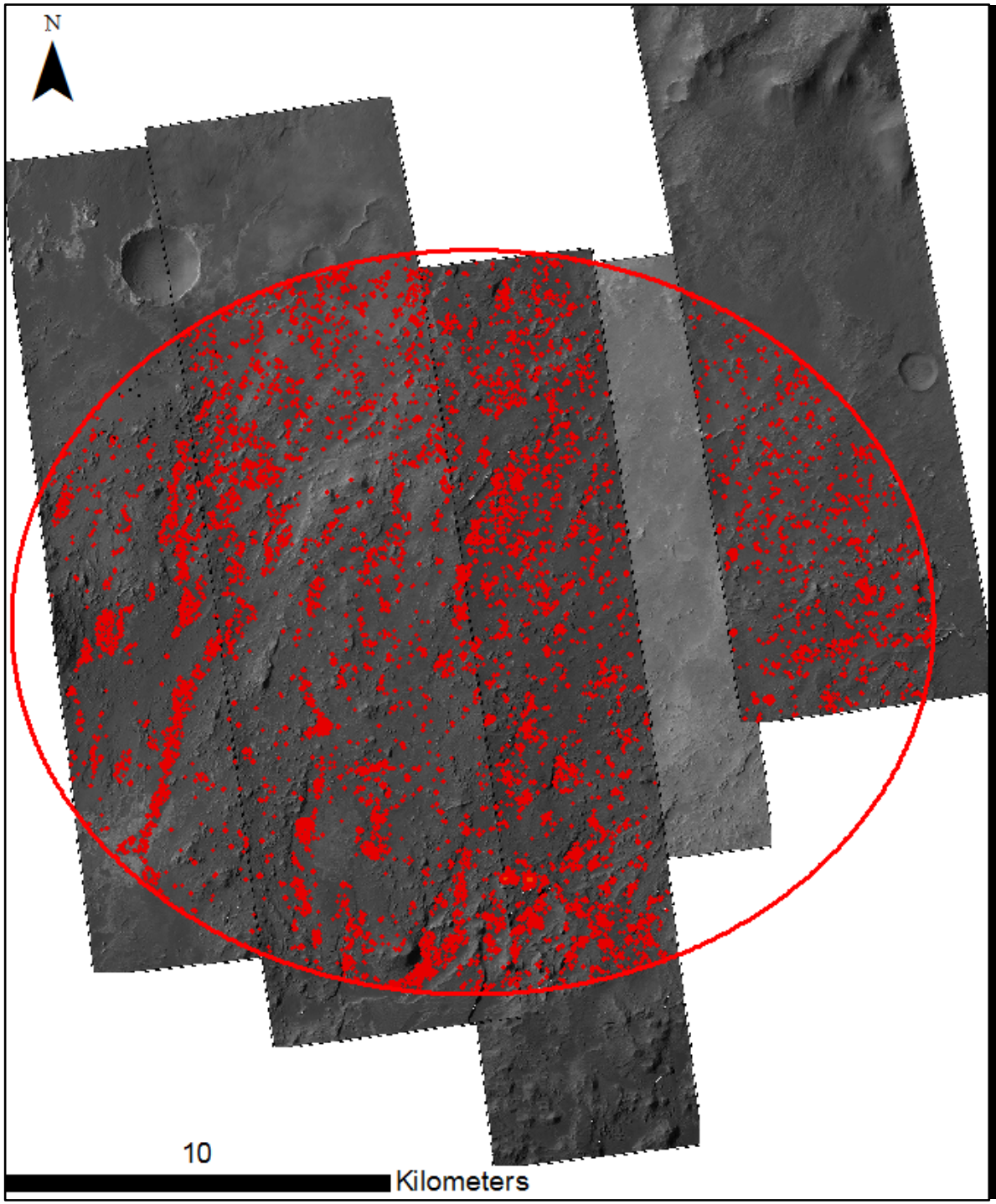
HiRISE image PSP_010882_2040

Uncratered Terrain



HiRISE image PSP_010882_2040


A
10 m
HiRISE image PSP_010882_2040
B
10 m
HiRISE image PSP_007612_2045
C
10 m
HiRISE image ESP_011884_2045
D
10 m
HiRISE image PSP_008825_2040



Eberswalde

- ~ 10,000 craters catalogued
- 303 km^2 covered
- Diameters ranging from 1 m to 275 m

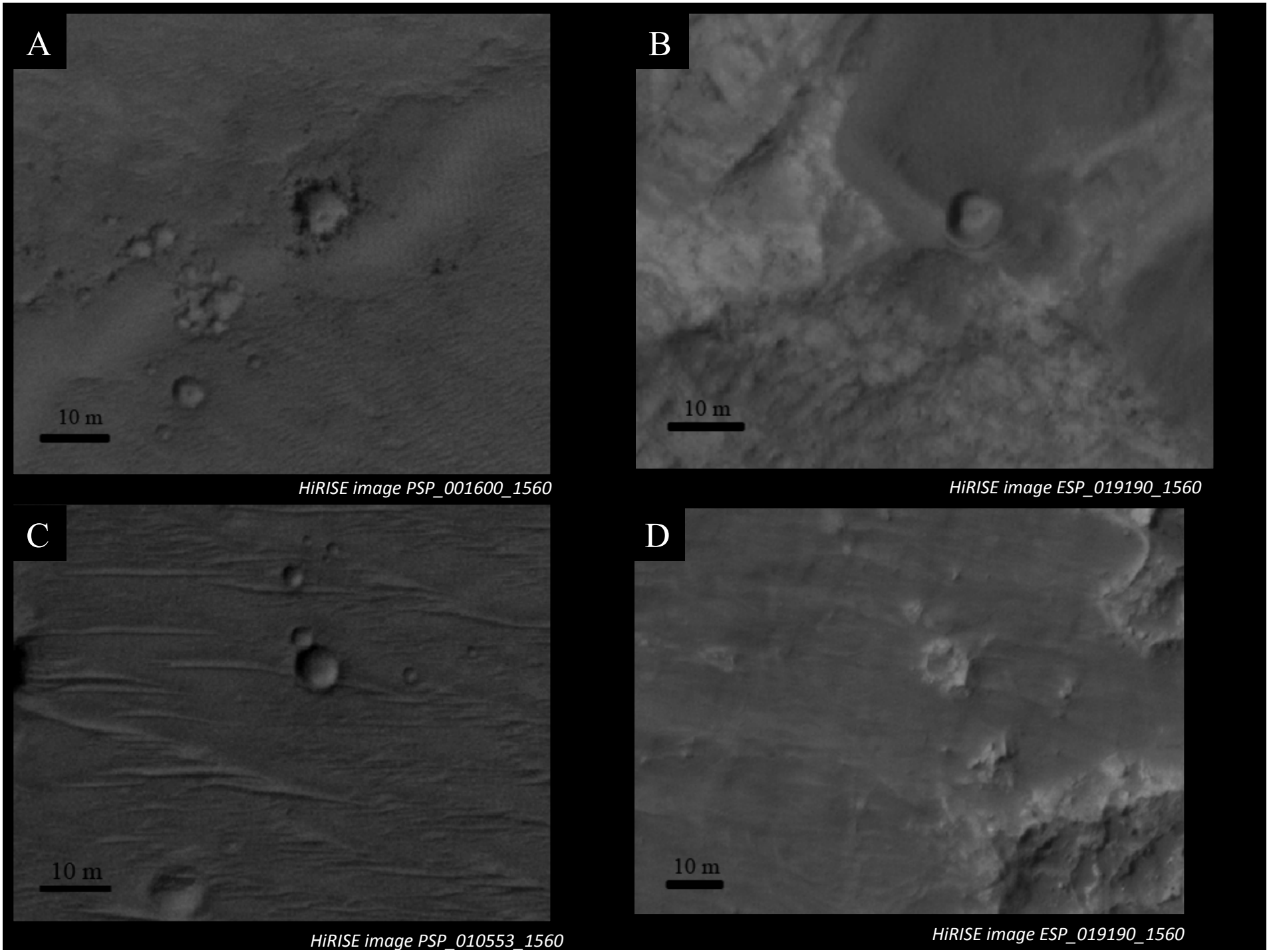
HiRISE image mosaic

Heavily Cratered Terrain

HiRISE image ESP_019190_1560

Uncratered Terrain

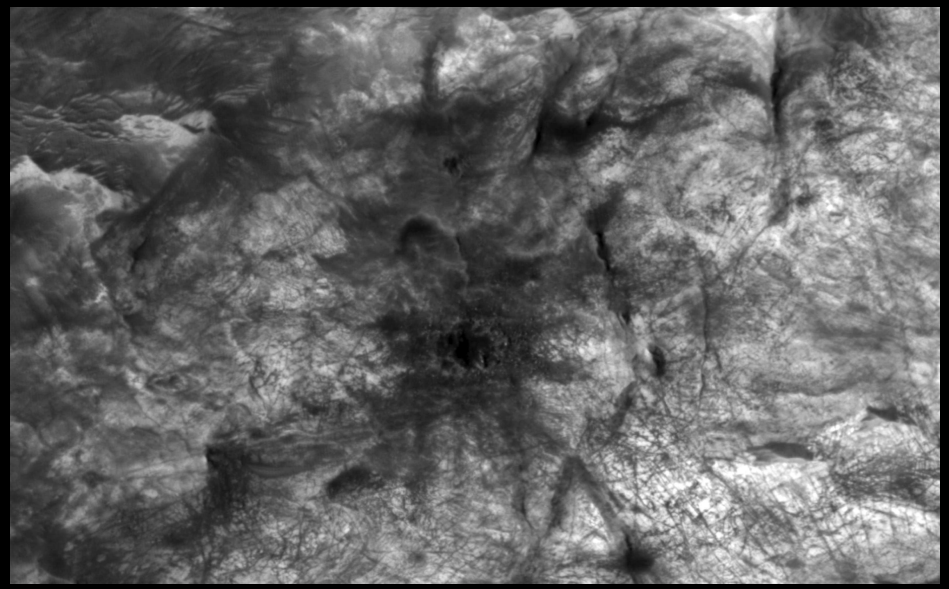
HiRISE image PSP_010474_1560


A
10 m
HiRISE image PSP_001600_1560
B
10 m
HiRISE image ESP_019190_1560
C
10 m
HiRISE image PSP_010553_1560
D
10 m
HiRISE image ESP_019190_1560

Conclusions

- Each site retains many small, though subdued craters.
- Several fresh craters in each ellipse provide opportunities to sample the subsurface geology within the landing ellipse.
- Further study can help identify which of these fresh craters are best to sample with the MSL suite of instruments.

Small rayed craters in or near the MSL landing ellipses: insights into the recent erosional history and potential sampling locations at each site



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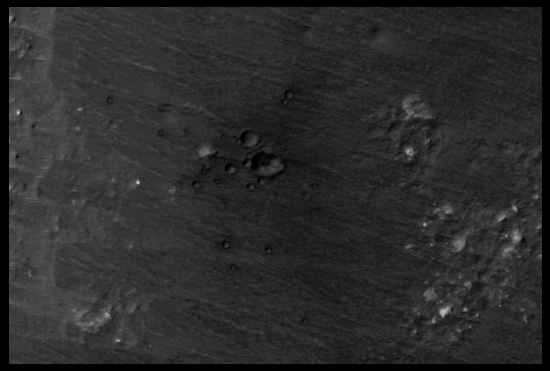
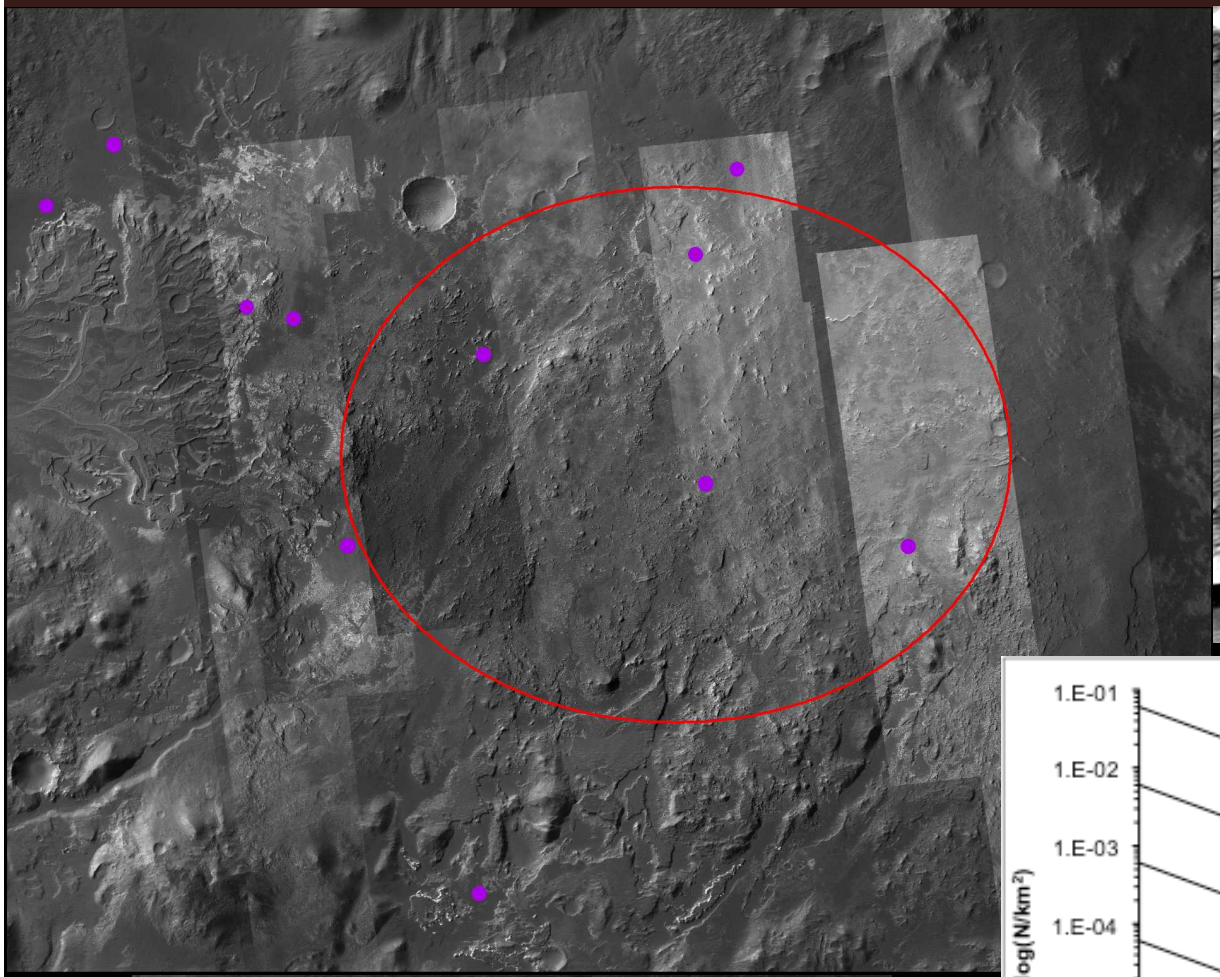
JPL/Caltech

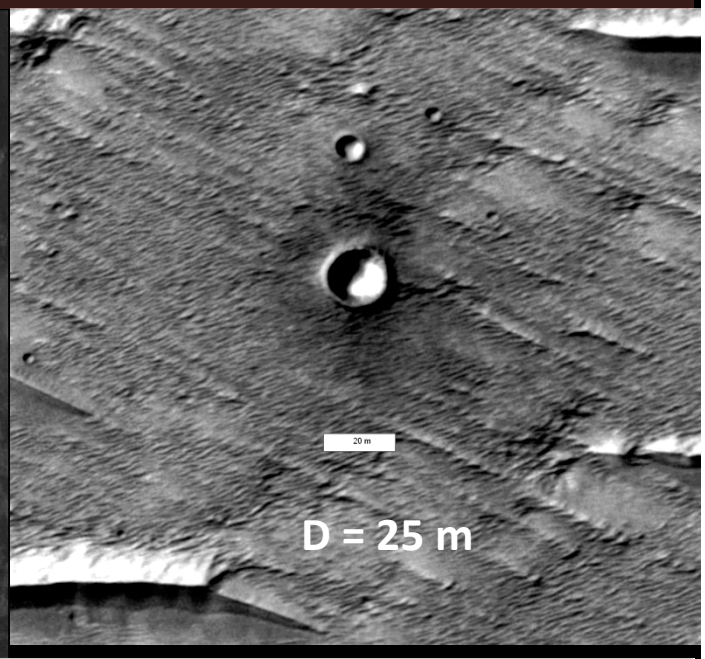
STUDY GOALS

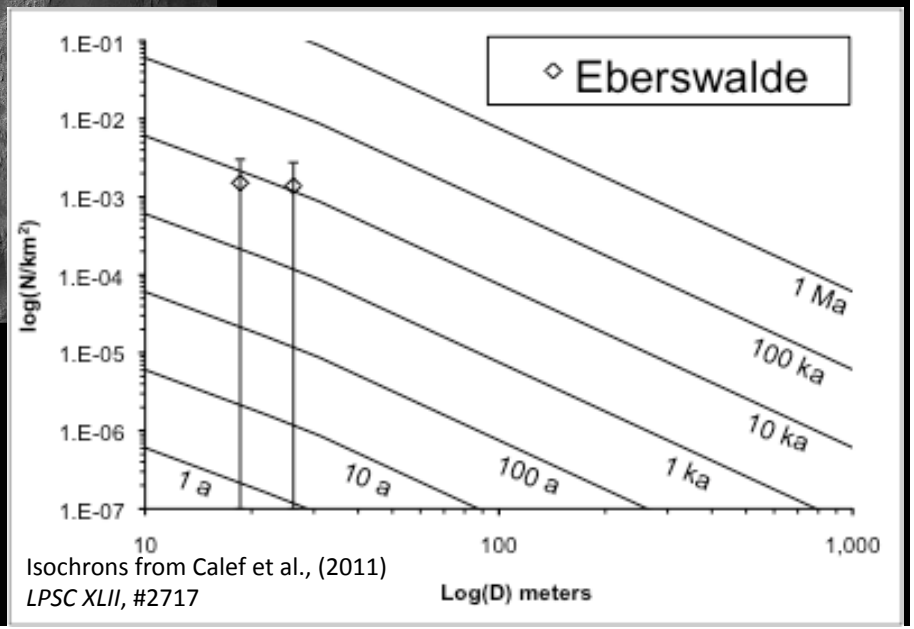
- Identify small rayed craters (D<1km) (SRC) to calculate *ejecta retention ages at each MSL site as a proxy for recent erosion. (the length of time ejecta remains around a crater rim)
- Determine “freshest” SRC in each landing ellipse.



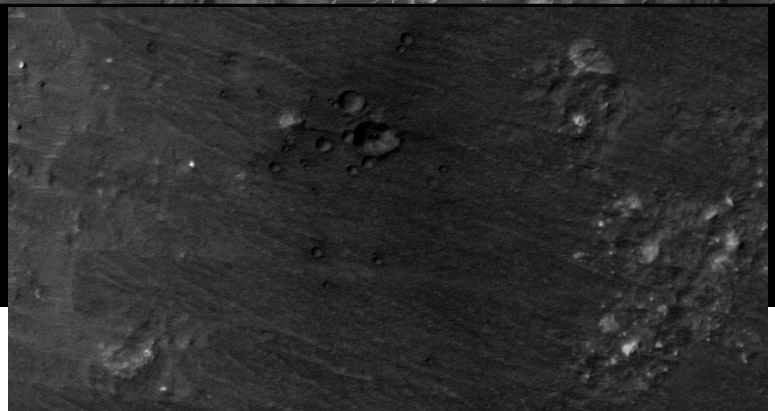
Eberswalde



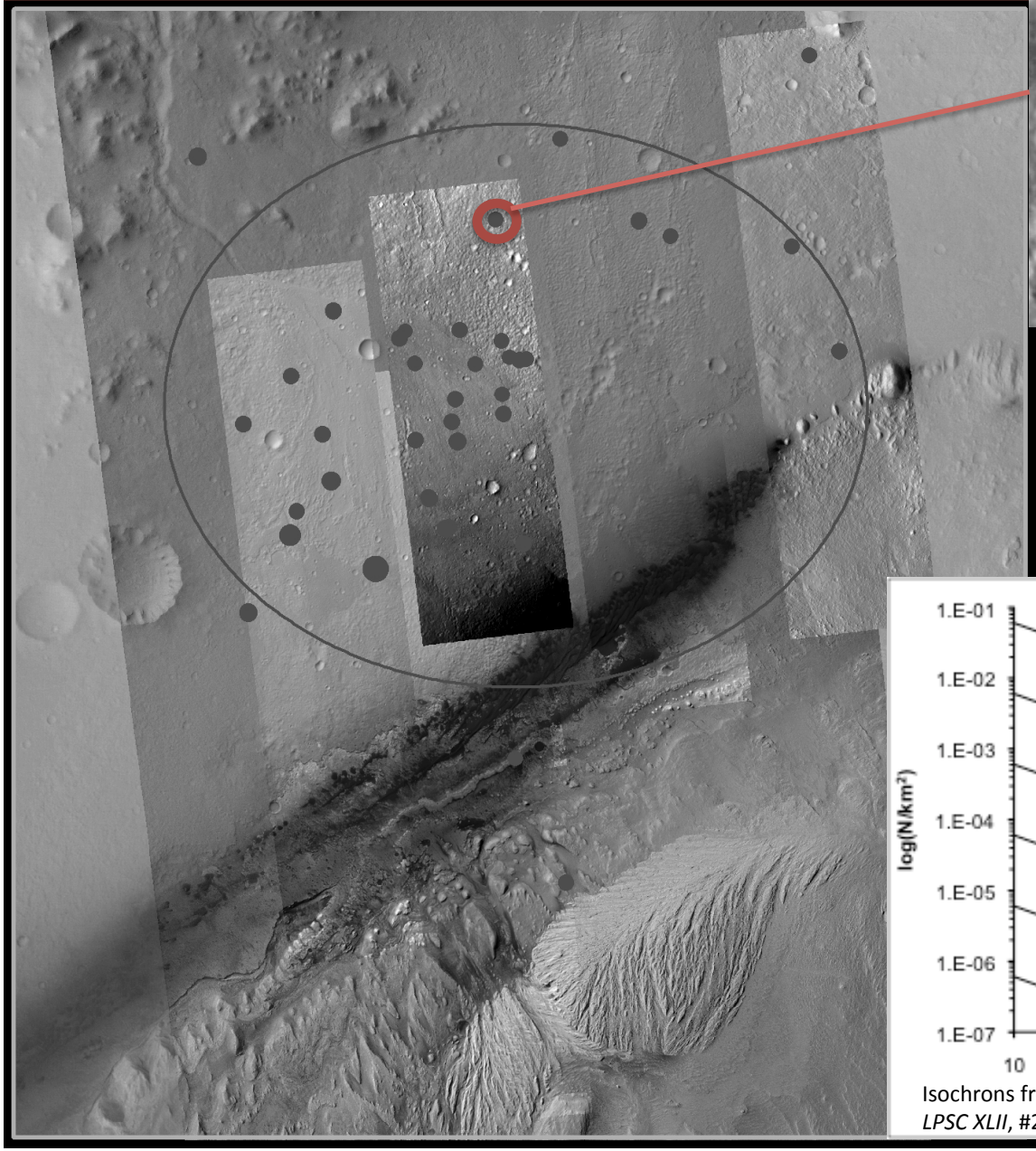


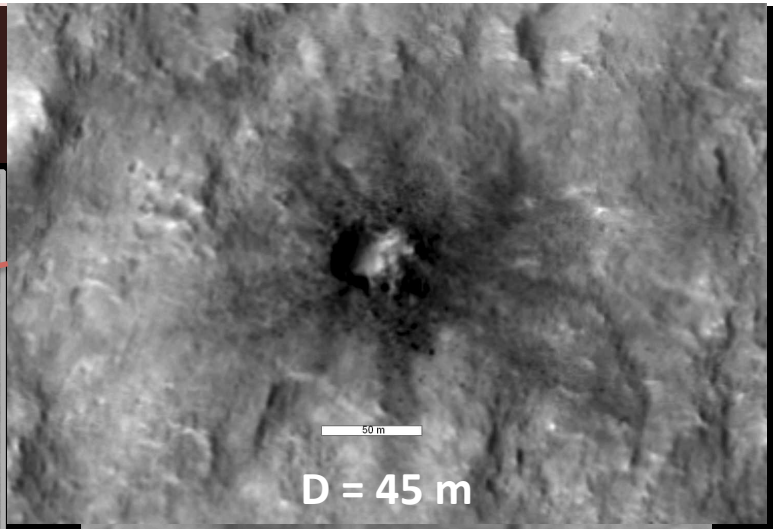


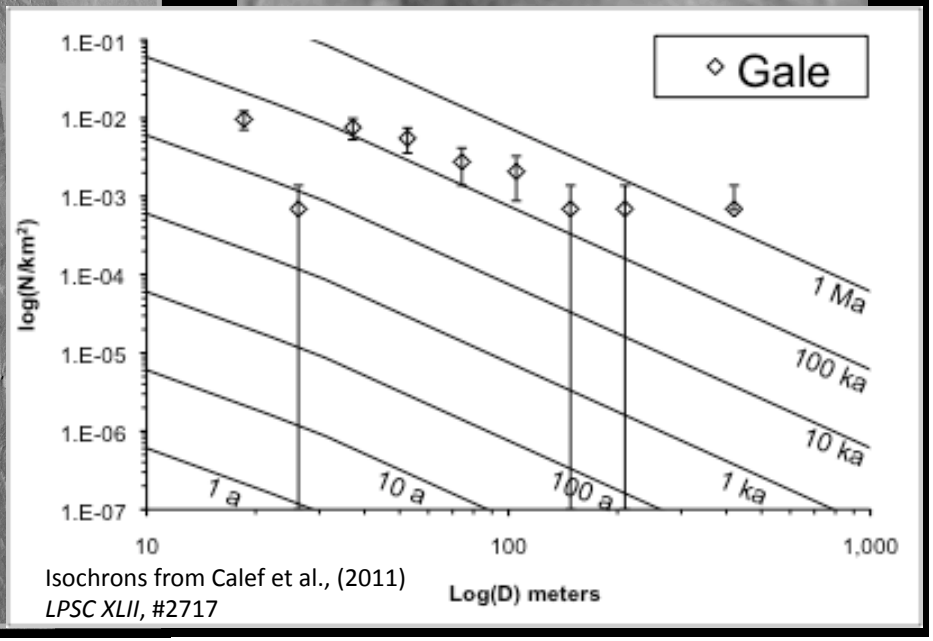
Isochrons from Calef et al., (2011)
LPSC XLII, #2717



Gale

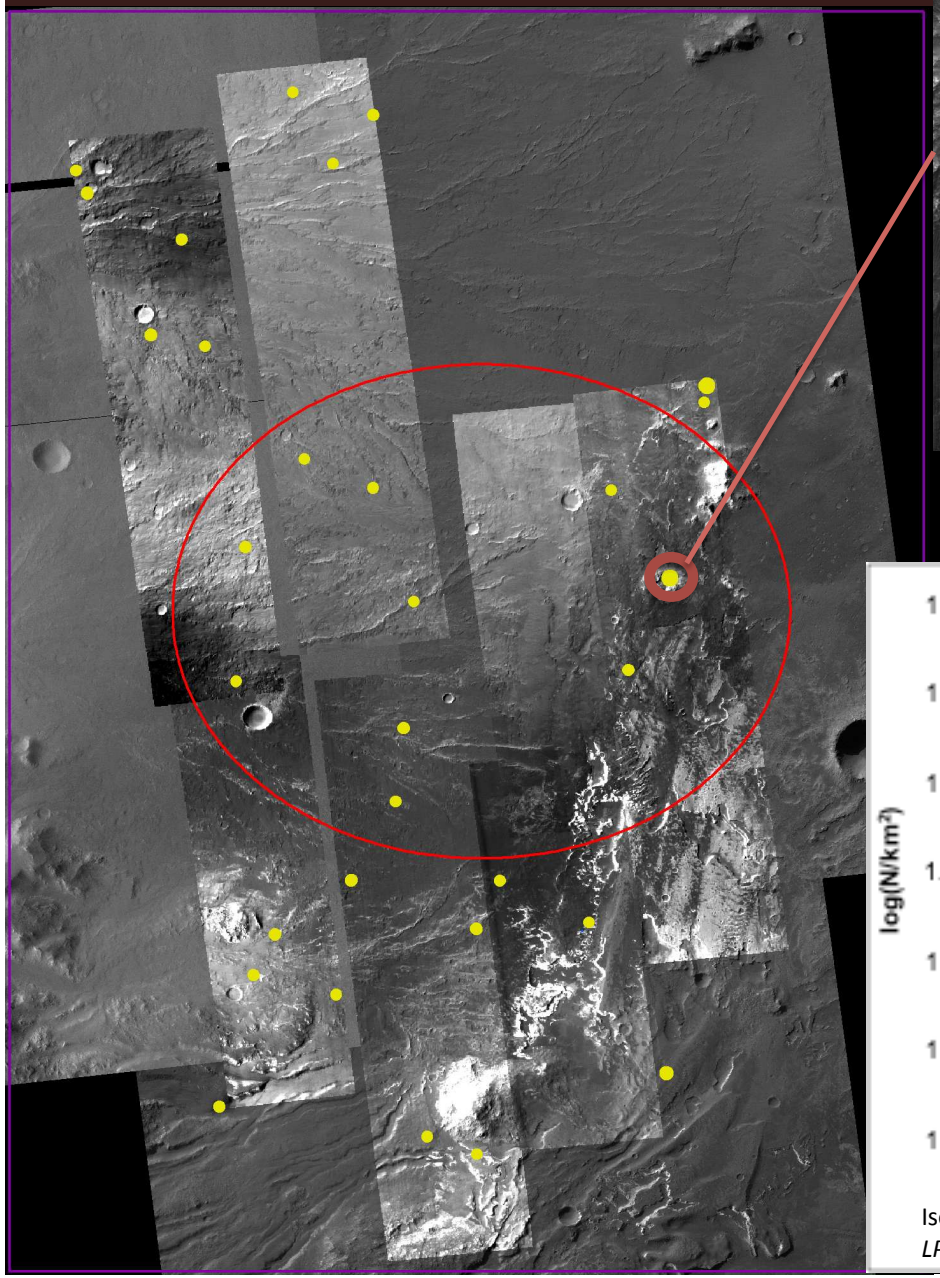


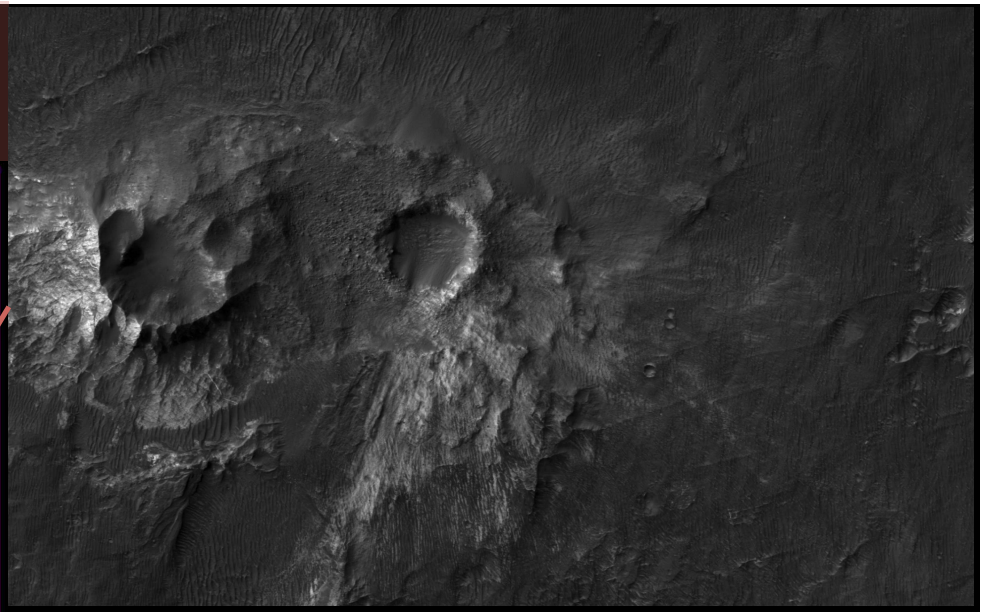




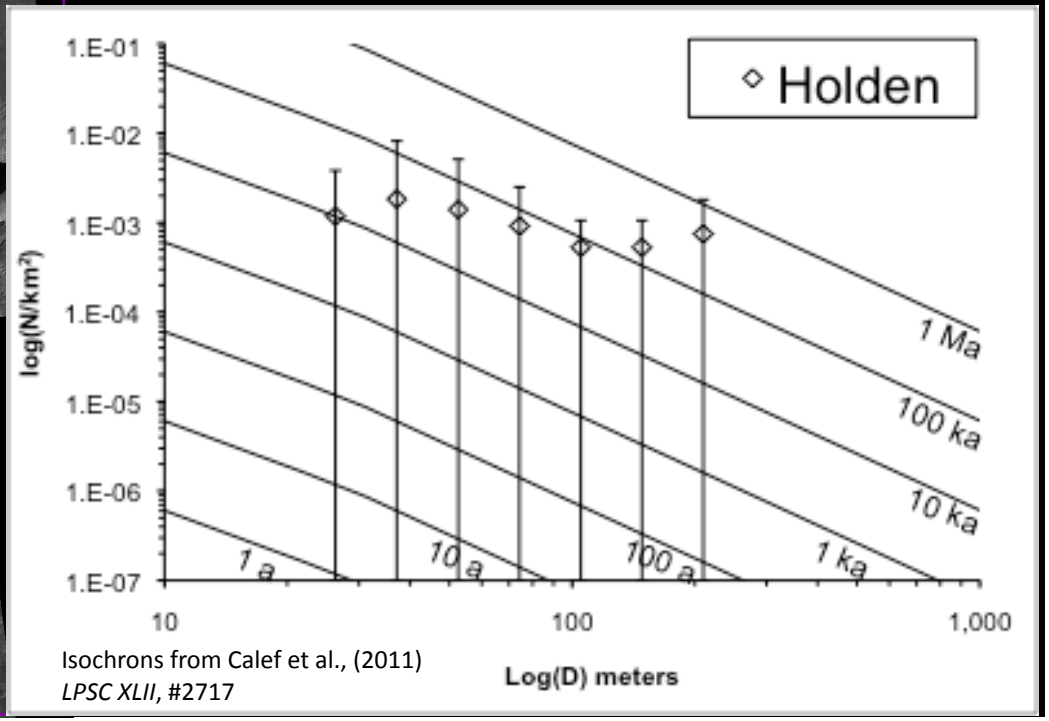
Isochrons from Calef et al., (2011)
LPSC XLII, #2717

Holden



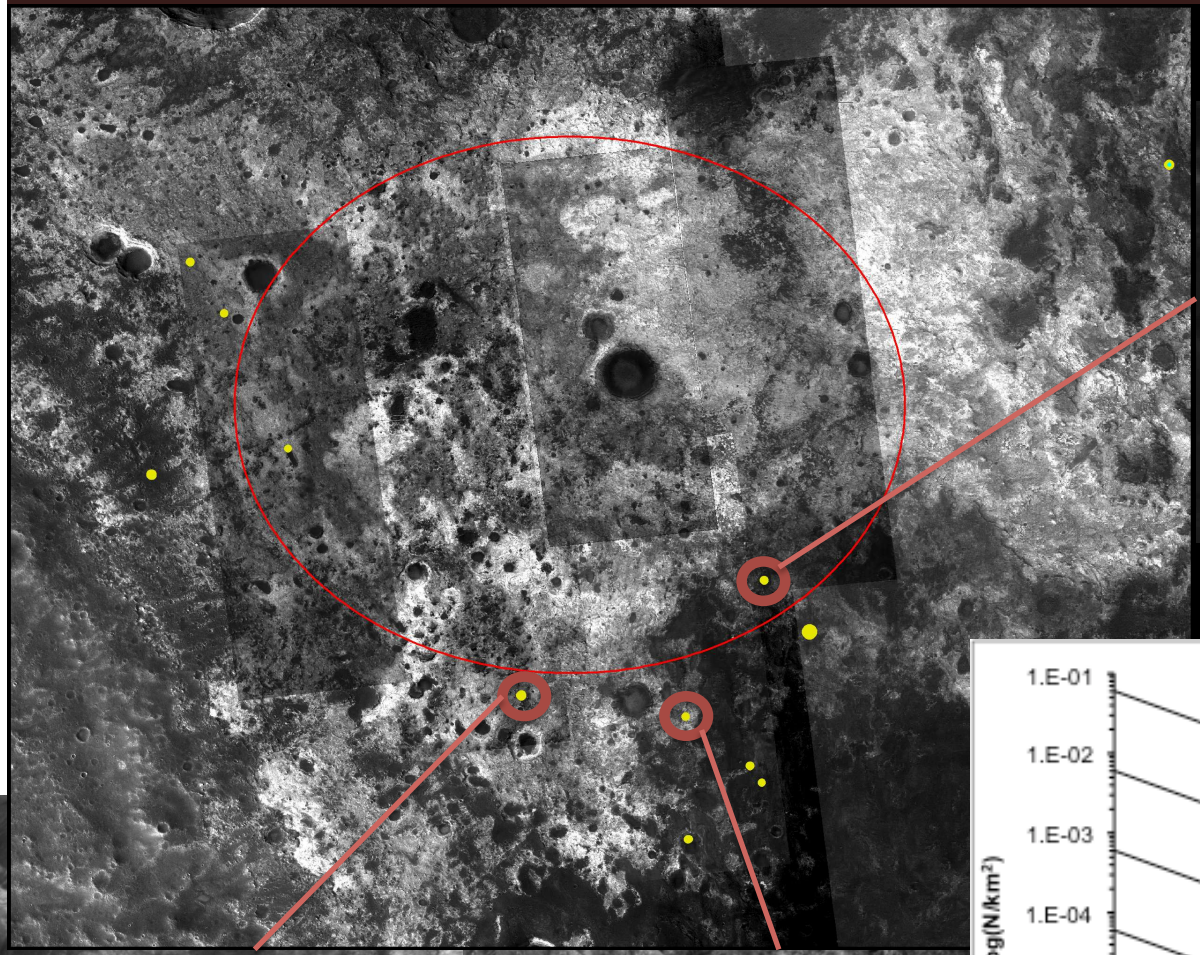


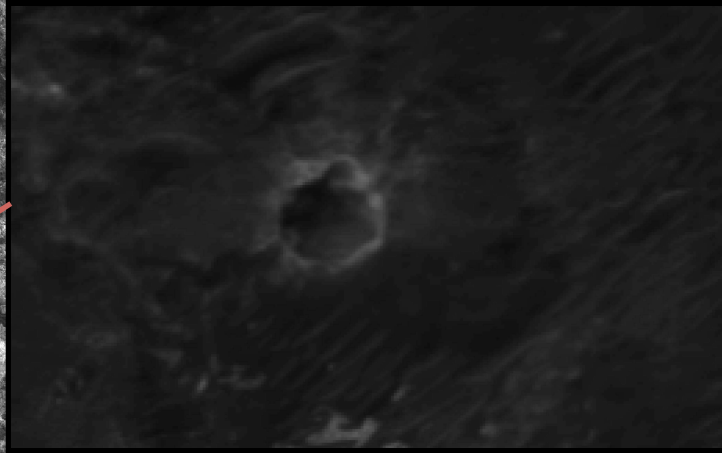
D = 235m



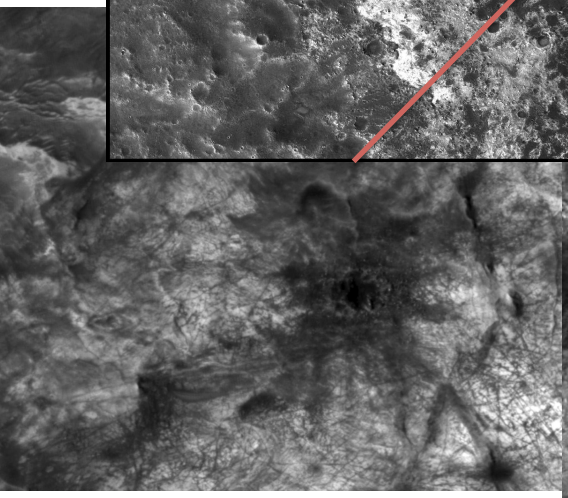
Isochrons from Calef et al., (2011)
LPSC XLII, #2717

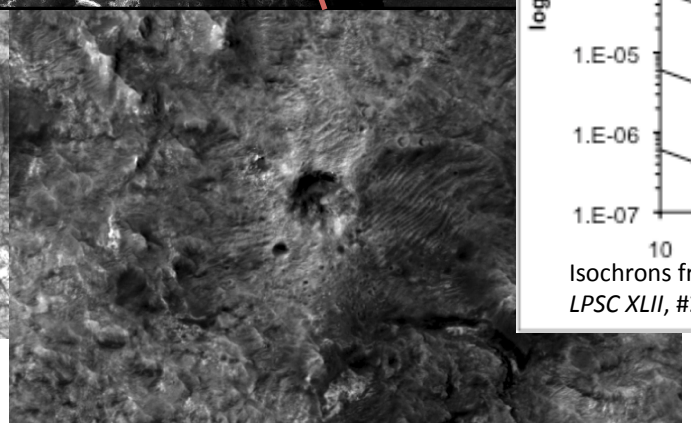
Mawrth

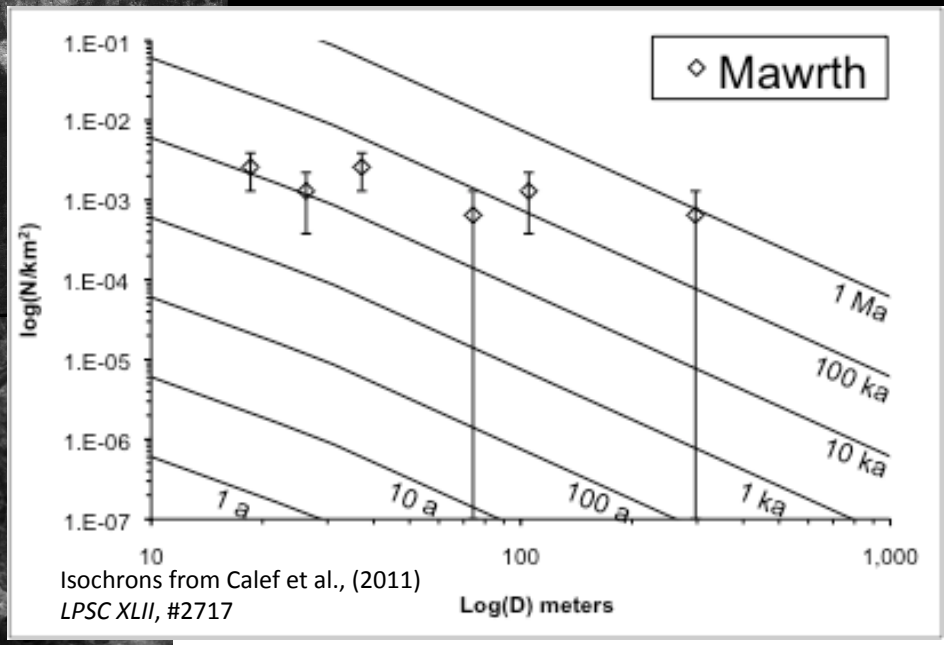




D = 38 m







Isochrons from Calef et al., (2011)
LPSC XLII, #2717

Conclusions

- Gale has "oldest" ejecta retention @ ~300 ka (i.e. eroded over longer timespan), followed by Holden @ ~80-120 ka.
- Mawrth has ages ranging from 10 ka – 1 Ma (eroding variably?)
- Eberswalde @ ~10 ka (few counts) has "youngest" retention (i.e. eroded over shorter timespans).
- Gale and Holden have several SRC that would make excellent "drive-by" sample targets.
- Eberswalde and Mawrth have few useful "fresh" craters in their ellipse.